Evaluation of Some Genetic and Non - Genetic Factors Influencing the Perfomance of Layer Chickens in South Western Nigeria

[1]K.T. AKANNI, [1]O.A. OSINOWO and [2]G.A. AJAYI
E-mail: kalerabbit@yahoo.com
Study Area: Animal Breeding & Genetics
[1]Department Agricultural Education,
Federal College of Education, Abeokuta, Nigeria.
[2]Department Primary Education,
Federal College of Education, Abeokuta, Nigeria.

Abstract
This study was conducted using 5 chicken genotypes comprising 3 exotic purebreds, Nera Black (NB), White Leghorn (WL) and Giriraja (GR), Nigerian Local chicken strain (L) and improved local (B Alpha crossbred). The laying performance of these chickens was monitored to evaluate genetic and non-genetic effect on egg production traits. A total of 506 pullets were evaluated for effect of genotype and season on laying performance. Genotype significantly (P<0.05) affected all production and egg quality traits. Giriraja had the highest body weight at first egg (2107.00 ± 4.0.1g) while White Leghorn had the lowest (1259.62 ± 9.83g). However, Nera Black had the highest weight of first egg (48.52 ± 0.52g) compared with 33.11± 0.01g by White Leghorn which was the lowest. Egg quality traits also followed similar pattern as observed in egg production traits. Results from the study revealed that specific values of age, body weight and performance traits for a particular group of birds in a particular area are unique but other non-genetic factors such as season could subject the value to modification: this suggests that the genetic potential of the Nigerian indigenous chickens can still be improved upon by crossing with exotic strains, as a panacea for sustainable goals of vision 2030 for layer chicken development in humid and sub humid zones of tropical climate.

Key Words: **Genetic, Non-genetic, Production traits, Productivity, Season**

Introduction

The phenomenon of gene by environment interaction controlling the performance traits in poultry productivity has been a subject of great concern in poultry industry especially in tropical climate characterized by heat stress (Akanni, 2017). Most of the studies conducted by Merat et al. (1994) considered locations as environments and specific strain as genotype. Genotype is the sum total of all genetic traits transmitted or inherited from the parents to the offspring. While environmental factors include effects of nutrition management housing, season, temperature and humidity (Akanni et al., 2008a and b; Akanni et al., 2018a and b; Akanni and Ajayi 2021).

There is wide spread of malnutrition and undernutrition due to protein deficiencies which is as a result of inadequate and poor animal protein consumption (Akanni, 2012). Animal protein supply has also been reported inadequate because of low population of livestock in relation to human population, low level of animal productivity in terms of slow growth rate, slow reproduction cycle, slow milk, meat, and egg yield which has direct influence on general well-being and health of the ever-increasing population (Adejinmi et al., 2005; Fapounda et al., 2005; Akanni, 2012). However, poultry products are among the most valuable sources of animal protein available for human consumption. These products offer means of meeting the animal protein deficiencies in many African countries. In most of these countries, demand for eggs and poultry meat far outstrip supply, as evidenced by steep rises in prices in the last sixteen years (Akanni et.al.,2008a). One egg weighing 55g/day meets the 50% protein requirements of a child up to five years of age (Akanni et al., 2007). Meanwhile, at the present time, egg and poultry meat have been priced out of the reach of vast majority of the common people, with frightening consequences for health, growth, well-being and productivity.

The local chicken population has a preponderance of survival genes to the detriment of productive genes. These may be partly due to the fact that the birds have not been subjected to adequate genetic selection for increased productivity, but more to natural selection by the adverse environmental conditions. Several researches have been conducted towards the effective genetic improvement of Local chicken by many researchers across the different ecological zones of the country (Ikeobi et al., 1996; Adebambo et al., 1999; Akanni et al., 2008). All improvement methods make use of information on phenotypic and genetic performance of the birds. Several surveys on local chicken population and production have been carried out and reported from many parts of the world, particularly in African countries. Limited information is available on the effect of gene by environment interaction especially in the humid climate, which has not been thoroughly studied and reported.

To achieve this, the focus is on all traits related to laying rate and persistency of egg lay of hens (Bradford, 2016). Persistent hens can maintain a level of constant egg production at their peak (Grossman et al., 2000). Persistency of egg lay has mathematically been described using non-linear models (Grossman et al., 2000). These models fit egg production and curve parameters with biological interpretations, and capture rate of increase in egg lay prior to and/or decrease from the peak of egg-lay, week of peak production, as well as duration of persistent egg production and rate of decline from peak of production. This makes it possible to establish parameters and descriptors that fully capture egg production patterns in laying hens (Poomkasemsak et al., 2015; Adeniyi et al., 2018).

The performance of laying birds is monitored through its performance characteristics and majorly from its egg production, in capacity and efficiency of feed utilization for egg production. These attributes are under the control of factors, which are both innate (genetic) and external (non genetic). A close study of these factors will help in understanding the exotic, indigenous and crossbred chickens and their performance (Akanni et al., 2007).

Genetic factors influencing the performance of layers in humid environment

The innate or genetic factors associated with the genetic make up of the animal contribute a great deal in majorly in egg laying characteristics of the chicken. Investigation conducted by Ikeobi et al. (2004) to determine the effect of major genes of frizzling and Naked neck on the external and internal egg quality traits of the Nigerian local chicken showed that egg weight significantly ($P<0.001$) favoured the frizzled local chicken and the naked-necked chicken over the fully feathered (normal) local chicken. The result also indicated that the frizzling gene F caused an increase of 8.13% in egg weight while the naked neck gene, Na, increased egg weight by 5.85%. Egg of frizzled locals also had significantly heavier yolks ($P<0.01$) compared to the naked neck chickens and the fully feathered local chickens. The other traits studied (egg width, egg length, albumen weight, shell thickness, albumen pH and yolk colour) were not significantly affected ($P>0.05$) by the major gene. They however concluded that the two genes from the Nigeria local chicken can be utilized in breeding programme to produce a highly commercial egg strain.

Studying the laying performance of some chicken genotypes up to 125 days of ages Adedoyin et al. (2004) recorded a significant difference in egg number and egg weight ($P<0.05$) among the four genotypes. The Giriraja had the highest egg weight of 51.09 + 0.22g, Giriraja x White leghorn (49.87 + 0.21), Giriraja x improved local (49.22 + 0.21) and Giriraja x local (43.88 + 0.18). The conclusion drawn from this study showed that genetic influence is an important and predicting factor of egg number and egg weight which are the traits of paramount importance in egg production, selection and breeding in poultry industry.

Age in breeding context is normally referred to as age at first egg (AFE) or age at sexual maturity which is the number of days after hatching when the first egg is laid provided that a second egg is laid in the next 10 days (Akanni, 2017). Adenowo et al. (1995) in their study found a positive correlation between the age at first egg and egg weight and concluded that as long as age at first egg and egg weight are positively correlated and most non-additively inherited, selection based on one or few of them especially in the crossbred will produce favourable response in other traits. They also reported a slight delay in sexual maturity of crossbreds. Alex (2001) reported that the older the pullet is before the first egg is laid, the larger the average egg size will be over the production cycle. Also as the bird ages in the production cycle, the weight increases and thus egg size increases.

Body weight of pullet at first egg is the weight in grams taken immediately after the first egg is laid. Body weight at first egg is controlled by non-additive gene effect (Adenowo et al., 1995). They also observed that body weight at first egg has been found to depend, to a large extent, upon age, thus, those that mature when relatively young weigh less than those that do not begin laying until they are older. The exotic chicken has higher body weight than the indigenous. He also reported body weights of indigenous chicken pre selection at 4, 12, and 20weeks of age to be 129.5g, 628.3g and 968g for females respectively. On the average, the body weight of both the 2 populations of local chicken studied varied from 25g to 85g with a mean of 46.1g at 14days of age and from 170 to 570g at 70days of age under intensive management. Correlations among AFE, BWFE and WFE, they reported, were positive.

Body weight at sexual maturity is an important trait, which affects egg size. A positive correlation exists between body weight and egg size (Alex (2001). Increased egg size with increased body weight at first egg as well as increased egg weight with increasing body weight at laying had been reported. He found that the correlation between body weight and egg weight was positive (0.35 and 0.26) at sexual maturity. It appears that every flock has an optimum body weight at sexual maturity. If the flock falls below the optimum level, its relationship with egg production would be positive. On the other hand, if it exceeds the optimum level, the relationship would be negative; lighter birds produced a greater number of eggs compared to heavy birds and that the negative association could arise as a result of fat deposition in large bodied hen. Uniform body weight is the goal of producers. Birds stimulated to lay too early or before reaching target body weight for maturity will lay eggs with a lower-than-average weight throughout the laying period (Alex, 2001).

Egg number is a compound trait influenced by polygenic action. The number of eggs produced by the hen either as part or full is a result of correlated responses to production component, which include age and body weight at first egg clutch number and egg size, pause number and pause length as well as broodiness (Akanni, et al., 2007; Akanni et al., 2008).

Egg weight is an important economic trait in pullets and a lot of researches have been conducted into the relationship between egg weight and age and body weight at first egg as it affects egg production in imported strains and their crosses with the indigenous strains (Adenowo et al., 1995). The size of egg is commonly expressed in terms of weight, which provides a more convenient basis of comparison than dimensions or volume. Egg weight varies immensely among species. Hen eggs normally weigh from 40 to 80g each. The highest recorded chicken egg weight was 320g and the smallest was 13g (Alex, 2001). Size of the first egg is closely associated with body growth, which is related to the time of hatching. The first egg laid by a pullet is almost her smallest egg and the size of the first egg is a good indication of the relative size of the eggs that a bird will lay in the future. If the first egg is large, the bird usually continues to lay large eggs (Alex, 2001).

The wide variation in weight exhibited by eggs as reported by Alex (2001) could lead to the conclusion that egg size (weight) is the result of many complex biological phenomena which includes;

(i) Age of the pullet (Alex, 2001)
(ii) Yolk weights (Alex, 2001)
(iii) Breeds and genotype differences (Alex, 2001; Adedoyin et al., 2004)
(iv) Nutritional deficiency (Alex, 2001).

Non genetic factors influencing the performance of layers in humid environment

These factors are also known as environmental factors that plays paramount role in the performance of laying birds. The nutrient required for metabolic, productive ability and reproductive capacity differ between classes of poultry and vary with age, sex and environment for the same specie of birds, particularly the laying hens which are well defined more precisely than for other domestic animals. Alex (2001) reported the ideal layer as an active, lean and small bird that put all of its effects in producing a lot of large eggs. Based on the genetic and physiological function of a bird, it is not capable of producing more than 300 eggs in the first cycle. These authors also noted that birds rarely exceeded this level of production. However, in the tropics, egg production is much lower and has remained at 180-210eggs in the first year although higher levels have been reported.

Protein is important in the diet of layers especially for egg production since an egg consists of 13-14% protein. Egg production and egg weight depends on the protein level in the feed. Experiments have shown that birds on 16% protein consistently laid larger egg than those on 14% protein. Layer chickens are more sensitive to nutrient needs and balance diet than mammals since their body processes are more rapid which makes nutrients or feed intake to be an essential environmental factor in layer production (Adedoyin et al., 2004).

Temperature variation, which entails the extreme heat or cold, rain, wind or sudden changes in temperature and humidity, may have an adverse effect on the reproductive activity of the hen that causes physical discomfort, lowering vitality, reduced feed intake or restricting exercise and thereby resulting in reduced egg production (Alex, 2001; Adedoyin et al., 2004). This single factor accounts for the large differences between birds in temperate region and those of tropical environment hence it is regarded as a very important factor.

In Nigeria, high environmental temperature with lower relative humidity prevalent from the months of November to February tends to increase egg production. Also, a fall in environmental temperature below the thermo-neutral zone (the environmental range within which heat balance is maintained by physical means), brings about uneconomical egg production. This is due to increased feed consumption to maintain body temperature and reduction in egg quantity and quality. In poultry production, environmental temperature is usually expressed in terms of ambient temperature or optimum body temperature (Adedoyin et al., 2004; Akanni, 2017). Smith (1990) had earlier reported that at high ambient temperature, a reduction occurs in number of egg produced by the laying hens. Laying birds kept at optimum ambient temperature produce egg of higher weight than similar birds kept at lower ambient temperature.

The climatic condition in Nigeria as reported by (Akanni, 2012) has been partitioned into four seasons, which are as follows: -

(i) Early dry (ED) season (October - December)
(ii) Late dry (LD) season (January - March)
(iii) Early wet (EW) season (April - June)
(iv) Late wet (LW) season (July - September)

Akanni et al. (2017) investigated effect of season on reproductive performance of pure and crossbred rabbits in Nigeria and reported that the effect of season was significant on productivity traits of rabbit genotypes studied. The authors further reported that litter production highest in April to June and lowest in July to September. In a similar study conducted at Cuba on laying hens within 26 - 35 weeks of age, showed (a contrary result) that egg production was significantly higher from October to March than from April to September and lowest in July to September than from April to September. Eggs laid in summer as having poorer albumen and yolk quality but contained more yolk and higher yolk colour scores than those in autumn or winter. This indicated effect of season and breed on egg production in poultry.

Layer chicken houses are built to provide as much comfort as possible while keeping the cost and labour requirement as low as possible. Housed birds are usually protected from the vagaries of weather. Also, when birds are housed, it makes room for close observation of birds, which is very essential in order to maximize profit. The two common types of housing for layers are deep litter and battery cage systems. Akanni (2016) working on environmental variations and productivity indices of two ecotypes of Giant African Land Snails (GALS) fed

Moringa oleifera leaf Meal concluded that housing effect was significant for most traits most of which also exhibited genotype x housing type interaction effects. It was therefore concluded that contrary to popular belief, the indigenous fowl of Nigeria was more suited to the cage environment than the deep - litter for livability and egg production (Akanni, 2016; Akanni, 2017).

Almost the entire cost of producing an egg accrues from maintenance of layers; an appropriate intensity of egg production per layer had to be maintained to ensure reasonable results. One of major problems facing egg producer in Nigeria today is economic losses due to drop in egg production as a result of diseases and death of laying birds. Although some abnormalities of the reproductive organs of chickens may be of economic importance because of their effect on production. Such abnormalities are due to various causes. Infectious corhyza affects birds 2-4months of age. It occurred mainly in the months of January and March. Few diseases were recorded due to heat stress during hot spells. Other diseases such as Newcastle disease, which occur in the middle rainy season (when a short drought occurs or during early rains) usually leads to mortality of the birds and affects the performance of the survivors. Their performance is usually low resulting in low growth rate and subsequently low egg production. It is only in rare cases that complete recovery is possible (Abdou et al., 2002; Akanni et al., 2007).

A case study of possible health hazards associated with houses investigated by Bale et al. (2002) showed that modern husbandry practices, state or local concentration of the industry, high stocking densities, non-uniform age distribution of birds and continuous feeding may promote the spread of poultry diseases. Also, illness due to contaminated food, wastes, and poultry by products are one of the widest spread problems of the contemporary world.

Concepts and significance of egg quality in poultry breeding

Much information has been learned about eggshell quality during the past fifty years. During this period of time, the genetics of the chicken, diets, house design and management practices have changed dramatically. In the future, it is very likely that additional changes will have to be made by the commercial egg industry. No matter what changes occur, the eggshell needs to be as strong as possible to maximize the number of eggs reaching the market. Diverse relative amount of the major components are found in eggs laid at various different seasons by hens having different strains, ages and productivity. There is also a diverse relative proportion of the egg components when subjected to a variety of environmental conditions and fed sundry diets. The relative proportion of the egg components are modified by many of the same influences that affect the total weight of the egg. This is not surprising in view of the relationship existing between the percentage of the parts and the weight of the entire egg. This period of laying, season as well as breed differences seems to influence both weight and percent shell (Abdou et al., 2002; Akanni et al., 2007; Akanni, 2017).

Materials and methods

Description of the study site

The research was carried out at the Livestock breeding Unit of the Department of Primary Education, School of Early Childhood care Education and Primary Education, Federal College of Education, Osiele, Abeokuta, Nigeria. Osiele (7010'N and 302'E) is in Odeda Local Government Area of Ogun State, Nigeria. The experiment was conducted with birds comprised of the Indian bred Giriraja, White Leghorn, Nera Black, Nigerian indigenous (Local) and B-alpha (improved local) chicken strains between September 2016 and September 2017 for a laying phase that lasted for 52 weeks.

Management of birds

Birds from each genetic group were properly identified by wing tags at 12 weeks of age (point of cage), when the birds were transferred into previously disinfected laying cages. Each bird was kept in individual cage to monitor the laying performance. They were fed on a grower's mash that supplied 17.34% Crude protein and 2500.00MJ/kg metabolizable energy. Thereafter they were fed with a commercial feed containing 16.50% Crude protein and 2550 MJ/kg metabolizable energy (ME) at the laying phase. Feed and water were supplied ad-libitum throughout the period of the experiment.

Data collection

Performance characteristics

Laying performance of individual pullets in each genetic group was monitored from first lay to 52 weeks in lay. Eggs were collected marked according to bird tags and weighed daily.

Statistical procedure.

The effect of genotype on the laying performance traits was analyzed using the model:

$$Y_{ij} = \mu + G_i + e_{ij}$$

Where:

Y_{ij} = Observation on the jth bird in the ith genetic group;

μ = Overall mean;

G_i = Effect of the ith genotype (Nera Black, White Leghorn, Giriraja, Local, B - Alpha)

ij = Random residual error normally distributed with zero mean and variance (^{2}e).

Data obtained were subjected to one - way analysis of variance using General Linear Model of SAS (2012). Significant differences among means were separated.

Results and Discussion

Gene by environment influence on laying performance

Analysis of Variance (ANOVA) showed that there are significant ($P<0.05$) differences in the performance traits in terms of age at first egg, body weight at first egg, weight of first egg and egg quality traits among the genetic groups studied (Tables 1,2, 3, 4 and 5) respectively. This could be due to variation in their genetic make-up (Akanni et al., 2007). Environmental factors in terms of seasonal changes, diet, water intake, temperature, humidity and management practices may also contribute to the variability observed (Akanni, 2008a and b). Many reasons could have been attributed to the variation in egg shape index of the chicken genotypes considered in this study, since egg shape index is the ratio of egg width to egg length. The difference in length and breadth of the egg laid is an important factor which could be as a result of variation in genetic make-up of the chickens. In sophisticated markets eggs that egg weight and shell weight to a large extent positively correlated. Apart from grading, egg shape index could also affect hatchability in laying hens as egg within the range of 0.75-0.78 Adenowo et al. (1995) concluded hatches better than the combined groups of the extremes which could result in embryonic mortality or dead -in -shell.

Good egg shape index enhances marketing and profitability, in that short round eggs do not make the best appearance and long eggs are much likely to be broken during packaging and transportation, since they do not fit squarely in convenient containers. Thus the highest egg shape index observed in Nera Black and B-Alpha is a reflection of high genetic value for shell strength which can make it withstand environmental stress. The low value of egg shape index observed in White Leghorn and Local therefore implied that eggs of these breed are more prone to breakage compared to Nera Black, B-Alpha and Giriraja. This is in agreement with findings of Belyavin and Boorman (1981) who observed that elongated (Low index) and heavier eggs were more prone to cracking.

Many reasons can be linked to the differences observed in the various internal egg quality traits as contained in Tables 2, 3 and 4 respectively. Variation is both genetically and environmentally influenced. Strain of layer has been found to influence egg quality. Working with Brown and White Leghorn type layer chicken, Suto et al. (1996) and Akanni et al. (2017) in their separate studies also observed significant effect of genotype of layer on egg quality traits, indicating that egg quality is a breed characteristic. Diets that are deficient in calcium, or vitamin D, result in thin egg shells. The shell thickness observed falls within the ideal shell thickness reported by Smith (1990) (approximately 0.35mm). Although environmental factors that affect egg weight are known to influence albumen height, genetic make-up is known to exert stronger effect on this particular trait.

The trend of Haugh Unit among the genetic groups in this study was in agreement the report of Noddegaard (1992) Adenowo et al. (1995) and Akanni et al. (2008b) and Akanni et al. (2017) who observed increased Haugh unit with increased egg weight. This is because Haugh unit is a function of egg weight and the height of the albumen. This in turn depends to a large extent upon body weight and age of the birds. Giriraja and Nera Black having the highest Haugh unit are seen to have the highest egg weight. This shows that Haugh unit depends to a large extent upon genetic constituenys of the large chicken. The higher the unit the better the egg quality. Yolk colour differences are due to genetic and environmental effects. Although Salahuddin and Howlider (1991) cited in Akanni, et al. (2007) reported breed differences to be significant for yolk in egg type layers. The yellow colour of the yolk is caused by lipid-like compound known as Xanthophylls. This xanthophylls content of the yolk is almost completely dependent on the xanthophylls content of the bird's diet. This could have informed the results obtained in this study.

The practical genetic significance of the results is that pure and crossbred pullets need to lay for at least 273 days from the point of first egg before they are selected to make a meaningful assessment of their productive potentials in egg production as foundation parent stock. Better performance, as observed in White Leghorn shows that the breed possessed genetic potential for long term egg laying due to its lower body weight and age which make the bird an ideal layer, as informed the results obtained in this study.

Table 1: Analysis of variance for sexual maturity performance of the laying chickens .

Source	DF	Mean squares		
		AFE (days)	BFE (g)	WFE (g)
Genotype	4	300.416**	1760909.986**	1187.639**
Error	**33**	**3.322**	**25957.089**	**28.937**

** (Significant P<0.05); AFE = Age at first egg; BFE = Body Weight at first egg; WFE = Weight of first egg

Table 2: Overall least square means ± SEM of effect of genotype on external egg traits

Traits	Nera Black	White Leghorn	Giriraja	Local	B - Alpha
Egg Weight (g)	56.39 ± 0.00^{a}	53.06 ± 0.87^{b}	56.32 ± 0.87^{a}	45.81 ± 0.87^{c}	52.30 ± 0.87^{b}
Egg Length (cm)	5.14 ± 0.80^{b}	5.25 ± 0.80^{a}	5.17 ± 0.80^{b}	5.10 ± 0.80^{b}	5.05 ± 0.80^{b}
Egg Breadth (cm)	4.00 ± 0.04^{a}	3.85 ± 0.04^{ab}	3.87 ± 0.04^{abc}	3.76 ± 0.04^{bc}	3.88 ± 0.04^{ab}
Egg Shape Index	0.78 ± 0.01^{a}	0.73 ± 0.01^{bc}	0.75 ± 0.01^{bc}	0.74 ± 0.01^{bc}	0.77 ± 0.01^{ab}

a,b,c; Means in the same row with different superscripts are significantly different (P<0.05).

Table 3: Overall Least square means + SEM of the effect of genotype on internal egg traits

Genotype	Egg Wht (g)	Albumen Wht.	Albumen ht (mm)	Yolk Wht	Yolk Colour	Haugh Unit
Nera Black	56.39+0.00[a]	34.16+0.00[ab]	5.70+0.12[b]	15.43+0.02[c]	6.88+0.50[a]	74.86+0.22[c]
White Leghorn	53.06+0.87[b]	31.71+0.31[b]	6.17+0.74[a]	16.17+0.15[ab]	6.28+0.00[c]	80.81+0.11[a]
Giriraja	56.32+0.87[a]	34.46+0.49[a]	6.36+0.12[a]	16.57+0.17[a]	5.33+0.58[c]	80.84+0.16[a]
Local	45.31+0.87[c]	25.44+0.15[c]	5.63+0.70[b]	15.26+2.20[c]	5.93+0.10[b]	79.90+0.00[b]
B – Alpha	52.30+0.87[b]	32.44+0.25[ab]	6.14+0.45[a]	15.54+0.11[bc]	5.30+0.00[c]	78.84+0.00[b]

a,b,c,: Means with different superscripts in the same column are significantly different (P<0.05).

Egg Wht. = Egg Weight (g); Albumen Wht. = albumen Weight (g); Albumen ht. Abumen Height (mm), Yolk Wht. = Yolk Weight (g).

Table 4: Least square means + SEM of egg external traits as affected by season.

Genotype	N	Egg Weight (g)	Egg Length (cm)	Egg Breadth (cm)	Egg Index
Nera Black	35	61.93+2.05[a]	5.21+0.05[b]	3.93+0.03[a]	0.75+0.01[a]
White Leghorn	19	57.47+1.23[ab]	5.45+4.57[a]	3.65+0.05[b]	0.74+0.01[b]
Giriraja	12	62.47+2.56[a]	5.22+0.06[b]	3.93+0.05[ab]	0.75+0.01[a]
Local	11	49.08+0.68[c]	5.22+0.14[b]	3.75+0.09[ab]	0.73+0.02[c]
B – Alpha	7	55.11+2.61[bc]	5.17+0.08[b]	3.90+0.11[ab]	0.75+0.01[a]

a,b,c,: Means with different superscripts in the same column are significantly different (P<0.05)

Table 5: Overall Least square means + SEM of the effect of internal egg traits as affected by season

Genotype	Egg Wht (g)	Albumen Wht.	Albumen ht (mm)	Yolk Wht	Yolk Colour	Haugh Unit
Nera Black	57.22+0.00[a]	34.16+0.00[ab]	5.70+0.02[b]	15.73+0.02[c]	6.88+0.50[a]	74.33+0.02[c]
White Leghorn	55.11+0.00[b]	35.71+0.31[b]	6.17+0.74[a]	16.99+0.10[ab]	6.28+0.00[c]	80.08+0.00[a]
Giriraja	58.67+0.02[a]	36.44+0.09[a]	6.36+0.00[a]	16.47+0.10[a]	5.33+0.58[c]	80.84+0.00[a]
Local	47.31+0.11[c]	29.44+0.15[c]	5.63+0.00[b]	15.26+0.00[c]	5.93+0.10[b]	79.90+0.02[b]
B – Alpha	55.50+0.04[b]	35.44+0.25[ab]	6.14+0.01[a]	15.94+0.00[bc]	5.30+0.00[c]	78.74+0.00[b]

a,b,c,: Means with different superscripts in the same column are significantly different (P<0.05).

Egg Wht. = Egg Weight (g); Albumen Wht. = albumen Weight (g); Albumen ht. Abumen Height (mm), Yolk Wht. = Yolk Weight (g).

Conclusions

Egg production characteristics varied among the genotypes owing to the differences in their genetic constituents.

The better laying performance observed in White Leghorn, Giriraja and Nera Black revealed that the exotic chickens have been artificially selected for the productive traits; high body weight at sexual maturity, egg weight exhibited by Giriraja is due to the dual-purpose function of the bird.

Considerable performance of B-alpha in terms of heterotic advantage exhibited over the two extreme parents (Nera Black and Local) showed that our indigenous chickens can easily be improved upon and inculcated in Artificial Insemination (A I) programme.

Specific values of age, body weight and egg quality traits for a particular group of birds in a particular area are unique but other factors such as seasonal changes (gene by environment interaction) could subject the value to modification.

Considerable values obtained on the effect of non-genetic factor on egg production traits is a reflection of variability in the adaptability of chicken genotypes to varying seasonal / environmental changes across the year: this would mean that the day length (season), nutrition, housing, diseases and reproductive abnormalities among others, to a large extent affect production traits in layer chickens raised in humid and sub humid zones of tropical climate.

Recommendations

It therefore recommended that variations that exist in these chicken production traits should be thoroughly exploited through cross breeding and selection programmes. This is desirable in order to take advantage of heterosis. Also, a continuous crossbreeding and selection should be encouraged between Local /B - Alpha and exotic hens. The strains could be improved upon and developed into egg and meat type chickens to be raised semi-intensively for tropical environment.

Better values obtained on the effect of non-genetic factors on egg production traits as a reflection of variability in the adaptability of chicken genotypes to varying seasons should also be exploited: this would mean that the day length (season), nutrition, housing, diseases and reproductive abnormalities among others, to a large extent affect production traits and should be incorporated in breeding program for sustainable goals of vision 2030 for layer chicken development in humid and sub humid zones of tropical climate.

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